HOSPITAL STAFF INTERFERENCE WITH MEDICAL COMPUTER SYSTEM IMPLEMENTATION AND EXPLORATORY ANALYSIS

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INTRODUCTION

Background and Purpose

Although computerized information processing technology has existed in a commercially available state for over twenty years, its use in health care delivery facilities has lagged its use in other high and even moderate technology industries. The introduction of the computer to the medical field, when it did occur, was marked by some of the more noteworthy system failures of the last fifteen years. Why do systems based on the same technology which guided man to his lunar satellite fail in his hospitals? Why are such systems still failing?

Computer system vendors in the 1960s viewed the health care industry as virgin and profitable territory for their wares. In general, the systems they marketed were business transaction oriented with respect to their operating capability and efficiency and failed to contend with some of the more unique aspects of the

hospital setting. After a relatively small number of installations occurred, many were removed and generally only those dedicated to classical business functions such as billing, accounting, payroll, and personnel continued to operate. Isolated medical practitioners and information system researchers who developed their own task-specific application software met with significant success; but, the vendor-generated applications were usually undistinguished and a significant number failed acceptance testing or implementation. The reasons for most of the failures were seldom fully understood, and are now lost as the opinions of vendor and hospital personnel become accepted 'fact' with the passage of time. However, the reasons seemed to have been many. Frequently, hospital personnel claimed their system failed because its hardware and/or software was unreliable. Conversely, several system vendors assert that their system failed only because some hospital staff members were computer-phobic.

Today, the health care industry is one of America's largest, and the medically-oriented computer-based information system industry is quite active. Many of the largest and best financed medical computer system vendors of the sixties are no longer in the business of developing medical systems software. However, they have been replaced by many firms which, although smaller, are better versed in the hospital's managerial and operational idiosyncrasies. Hardware and software technology, especially in the database and telecommunications areas are at a state in which a large variety of medical and managerial applications are

feasible. Indeed, a large subset of these applications is in operation in hospitals in either production or prototype states. These applications range from the classical business functions to direct patient care support in the practitioner-patient encounter: computerized EKG interpretation, computer aided diagnosis, computer controlled scanning devices, automated clinical data collection and dissemination systems for clinical laboratories and inhalation therapy and radiology departments, etc. Further, much research is underway to crack some of the tougher medical information processing nuts such as multi-facility shared network 'total' hospital information systems and the classical individual patient health records systems. Unfortunately, development efforts are fragmented and the systems available through medical computer system vendors, which include shared systems, service bureau systems, in-house or remote proprietary software systems, and custodial systems, vary significantly in quality, reliablilty, and cost. Most are usually difficult or impossible to interface with each other. Still, for many applications, systems are available which work well and are cost-beneficial. But, even today, this latter subset of systems, the technically successful and operationally appropriate, frequently have very difficult implementations and often either fail and are removed from the hospital or are not used to their designed or intended potential.

Research into the causes of this problem has been sparse. Most current writing on the subject of medical computer based information systems (MCBIS) has been oriented toward an

explanation of the hospital systems in existance and how to design successful systems. General information systems research on this subject is useful but its application may be confounded by the fact that the hospital's organization and operation is different from that of most other industries. Additionally, the meaning of 'success' and 'failure', usually discussed by researchers and practitioners as a binary, 'either/or', factor, lead to significant confusion when discussing the state of health of MCBISs. We suspect that there are multiple factors which contribute to the problem whenever an MCBIS experiences less than planned-for success. Not all of these factors have been identified. Nor have the strengths of correlation between factors and an MCBIS's level of 'success' been established. However, the problems experienced by a government hospital when attempting to implement three different systems points to the possibility that resistance to a system by hospital staff, or their interference with its implementation and operation, may have a significant, direct correlation to the degree of the system's implementation problems.

This paper represents the beginnings of exploratory research into the staff resistance/interference problem. First, clarifications and definitions applicable to this research are discussed. Since no documented cases of staff resistance to MCBISs exist in the research literature, the three cases describing such incidents at the government hospital mentioned above will be presented. Then, diagnoses of the primary causes of

the resistance in the three cases will be attempted. They will be followed by a discussion of exploratory research undertaken to estimate the level of incidence of staff resistance to MCBISs in American hospitals. Finally, several conclusions derived from the cases and the level of incidence survey will be discussed. Rather than provide an exhaustive treatise on the staff interference problem, this paper is limited to establishing a possible basis for future research into this area.

The Staff Interference Problem: Clarifications and Definitions

Staff interference with an MCBIS implementation occurs when a member of the hospital's staff deliberately acts or fails to act such that he interposes in the planned MCBIS implementation activity so as to oppose, retard, hinder or impeed the implementation. Resistance and interference, hereafter referred to as interference, may be manifested in numerous ways. It may be covert or overt. It may be violent or non-violent. It may range from passive non-cooperaiton to physical destruction.

The interference investigated in this paper is not limited by motive or scope. However, since some resistance and interference may be harmless or constructive (eg: the devil's advocate), this research only focuses on instances in which the interference actually degrades the system's effectiveness or causes some type

of unplanned cost, regardless of intent. The issue of the staff's justification for interference is not considered here. Further, the issue of whether the interference caused the implementation problem or system deficiencies caused the interference is not addressed. Again, we are concerned with incidents of interference which, regardless of justification or causality, resulted in a tangible negative impact on the MCBIS's implementation.

In general, employee interference with the successful operation of an information system can be limited through various hardware and software mechanisms which limit access to a system to authorized personnel only (Hsiao, Kerr and Madnick, 1978). However, there is still the possibility that those employees purposely allowed access are the individuals who seek to resist or interfere with the implementation of the system. Let us call these individuals, who have access to the system as part of their work, the system's 'trusted agents'. In the MCBIS context, they would include the hardware operators (both CPU and terminal operators), the medical staff and hospital managers who were authorized access to the database, and the hospital's systems analyst and management staff. The research presented here restricts itself to examining the resistance or interference which may be manifested by those members of a hospital's staff who are:

-the trusted agents of the system;
-individuals in a position of power such that they are able to affect some aspect of the MCBIS's implementation; or

-influence leaders (Beckhard, 1977)
with respect to the prior two groups.

If interference to MCBISs is occuring in our hospitals, its ramifications are potentially significant. It could be one of the factors leading to the high variance in costs associated with similar logical application groups. If it delays a planned and budgeted implementation, it could place an unexpected constriction on the hospital's cash flow, a serious problem for most community or general medical and surgical hospitals. In most cases, if the interference causes the failure or disuse of some of the system's functions, the hospital would still be responsible for the purchase or rental fees for the entire system. Thus, the cost of the functions actually used is artificially inflated.

Should interference lead to system or subsystem disuse, it would cast a pall of unreliability on MCBISs in general. This is a very real problem in the health industry in which computer systems have had to prove themselves application by application to a generally reticient medical population in the past. In many cases, a system 'failure' caused hospitals to reject the consideration of other systems for a period of years.

Perhaps the most dangerous implication of interference is in the area of patient care. Should interference manifest itself in

erosion or partial and inconspicuous destruction of the database associated with a clinical application such as a laboratory information system, the integrity of patient data may by unknowingly lost. Potentially life-threatening patient care situations could result from a practitioner basing therapy on erroneous data. This scenario, unfortunately, is not far fetched. Should similar destruction occur in a hospital's management information database, inappropriate decisions could be made or management's loss of confidence in the potential of management information or decision support systems could ensue.

It is clear that the implications of interference may be quite serious. As a result, research into this subject is difficult. The hospital's release of information about instances of such interference have legal, ethical, and privacy implications. It is not surprising that this is not a frequently discussed topic. But the same reasons which make it a sensitive subject also make it potentially important. It also becomes apparent that the success or failure of an MCBIS is not an "either/or" situation. There are many cases in which a subset of a system's functions go unused by the hospital's staff. There are other cases in which the system is being used in a beneficial but unplanned way. There are still other cases in which the hospital is paying for a system but is not using it at all. What 'success' and 'failure' are and who defines them is a very moot issue. The research presented here does not attempt to define these terms. Instead, it controls for this by considering systems in all states

of 'success' or 'failure'.

THREE CASES OF STAFF INTERFERENCE WITH MCBIS'S

An Overview

The three cases of hospital staff members' interference presented here did, in fact, occur. Certain data about the cases have been omitted or altered to assure that the identity of the hospital remains disguised. However, in no case was this disguise allowed to alter the nature of the events as they are described.

These cases occurred at one of the 2,143 government owned hospitals in the United States during the mid-1970's. The hospital was a medium sized facility which served a population of approximately 70,000 people. The hospital had an active outpatient service attached to its inpatient facility and provided most medical specialties to its patients. It had a small computer systems staff (CS staff) which had developed and successfully implemented more than a half dozen applications during the two years preceeding the events described below. This computer systems staff had developed relatively good working relationships with most departments in the hospital and had developed a reputation for reliability and user advocacy. It was the CS staff which acted as the interface between the hospital and the system vendor in each case.

Each case represents the interference of one employee of the hospital. Each incident falls into the interference category of covert, non-violent sabotage, as defined in a standard dictionary: "2.....willful effort by indirect means to hinder, prevent, undo or discredit..." (Merriam, 1971). All of the incidents were researched, in vivo, by the author who was involved in their discovery.

Case I: An ECG Interpretation System

Mr. Alpha was the head medical technician of one of the two health screening facilities that the hospital operated. The two screening sections were co-located and differed primarily in the populations they served and a subset of the medical services provided. In addition to sharing the same building, the same physician staff provided medical support to both sections. The screening complex was located approximately ten miles from the hospital. Mr. Alpha functioned as the resident manager of his section in addition to filling in as an electrocardiograph (ECG) technician, general medical technician, phlebotomist or screening coordinator, when needed. His operation was entirely manual when it was decided by the hospital's management to implement a vendor provided remote processing ECG interpretation system for routine screening at the health screening complex.

The hospital's CS staff and cardiology department had been investigating ECG interpretation systems for over a year before the implementation of the subject system. The operating characteristics of the system which was actually implemented had undergone six months of testing and comparison with physician's results. After the testing was completed, it was felt that, although the system had an acceptable level of false positives and false negative interpretations for a screening facility, these levels were too high for the cardiology department's environment. The patients of the cardiology department had a much higher incidence of abnormalities than would be expected in an average screening population. Therefore, the system was to be removed to the health screening complex from the cardiology department.

The system itself was very similar, in operation and appearance, to the three channel ECG machines that the ECG technicians at the health screening facility used. The only operational difference the ECG technician would encounter was that after attaching the patient leads, the technician would establish a data communication link to the CPU via telephone lines by activating an auto-dialer. He would then proceed to operate the ECG unit normally. Approximately, three to five minutes after the trace was finished, the interpretation would be printed at the ECG room and would be forwarded to the screening physician before he would actually see the patient.

While planning the implementation, the hospital manager to which Mr. Alpha reported decided that the change to the MCBIS offered an excellent opportunity to combine the ECG operations of the two screening sections, thereby increasing the efficiency of the staff and utilization of the computer system. The CS staff developed a design for a refurbished ECG room which would allow two sets of patient leads to be connected to the ECG machine by a selector switch. One month later, construction of the room was complete and the system went into operation. There was still some confusion about its operation, however. Three technicians, including Mr. Alpha, had been trained and each demonstrated proficiency in the use of the system. But, the technician trained from the other section still had duties there and could not be counted upon to process his section's share of the patients. Hospital management decided to hire a new technician as a replacement for a person retiring from the health screening complex; but, the new employee would not arrive for two months. Hospital management left the two screening sections to work out a mutually acceptable work schedule. Mr. Alpha was instructed to contact the CS staff if any problems developed with the system.

As far as hospital management knew, the system was being used without difficulty, for Mr. Alpha had registered no complaints. But, six weeks after implementation, the financial manager called the CS manager to ask why the bill from the ECG system vendor was so low. The CS manager found that the fixed fee was correct but that the 'per ECG' charge indicated that only approximately thirty

ECGs had been taken. This was about 400 below the expected level. In response to a query from hospital management, Mr. Alpha had indicated that the health screening facility's physician staff was highly dissatisfied with the ECG system and had instructed him to discontinue its use. Hospital management immediately requested the cardiology department and CS manager to investigate. The cardiologists spoke with the screening physicians and learned that the system was highly unreliable in areas found to be satisfactorily reliable in hospital tests. Since the dual lead selector switch was the prototype, the CS manager, in conjunction with the system vendor, attempted to determine if it was at fault. It was found to be operating perfectly. As system and hardware problems were eliminated from the list of possible problems, hospital management was left with the operators to consider. An ECG technician from the hospital was sent over to the screening complex to assess the ability of the screening complex personnel to properly use the machine. They were found to be sufficiently knowledgable. It was noted, however, that during the personnel evaluations, the system did not malfunction. Further, it was learned that when the system was used during the first six weeks, Mr. Alpha was the operator. Next, the screening physicians were contacted. They indicated that they had not ordered that the system not be used. They had merely agreed with Mr. Alpha that it should be discontinued when he personally showed them all of the bad tracings and interpretations and had stated that it was too unreliable and labor intensive to use. Hospital management then confronted Mr. Alpha with the fact that the computer had nothing to do with the quality of the trace and that hospital

tests showed after over 1100 tests, that the system needed less than five percent more operator time than the standard ECG machine. Mr. Alpha responded in a beligerant manner that his facility was fine before they had forced the computer on him and disrupted his way of doing things. Shortly, thereafter the CS manager learned that another employee suspected that Mr. Alpha had deliberately misplaced the leads on the patients when he had taken the ECGs. Mr. Alpha was confronted with this suspicion and would not deny it. Shortly thereafter, Mr. Alpha indirectly disclosed to the CS manager that the earlier suspicion was, in fact, true. Further, he indicated that he could misplace the leads or use insufficient electrolytic cream for prober contact and that the computer would still attempt to interpret the trace. In fact, this was designed into the software since many patients generate weak signals or signals with high noise levels due to their inability to control their motion (eg: patients with Parkinson's disease). Hospital management immediatelly transferred Mr. Alpha to another job with constrained responsibilities. No problems were encountered with the system after Mr. Alpha's reassignment.

When Mr. Alpha produced bad EKG traces and the resultant erroneous system interpretations, he disrupted the ability of the hospital to render a consistantly good quality of patient care. Instead of repeating the ECGs that he degraded, the physicians, under time constraints, attempted to read the traces while the patient was still in the facility. Mr. Alpha then filed both the

ECG and the erroneous interpretation in the patient's medical record. He did not keep track of which patient's ECGs were degraded so it was impossible to exhaustively search the thousands of records stored in the hospital. More importantly, Mr. Alpha increased the chances that a cardiac condition which should have received attention was missed. Also, he cost the hospital the rental and variable ('per ECG') charges of the ECG interpretation service and many man-days of hospital management and CS staff problem research effort.

Case II: A Clinical Laboratory Information System

Ms. Beta had only been working as a clerk/receptionist at the clinical laboratory's reception desk for one month when the clinical laboratory information system (LIS) was installed. She had been hired specifically to augment the lab staff's data entry capability for the new system. The LIS design was developed by another government agency, the government's central systems staff. When the contract was awarded for the LIS, the hospital's lab, CS, and management staff were still not completely satisfied with the design. They noted several design deficiencies which could cripple the system in an operating lab environment. However, the whole hospital was aware of this and knew that since the contract had been awarded, they would have to implement the system and attempt to redesign troublesome subsystems under modification contracts. LIS would radically alter the information processing

methods used by the lab. However, it would not significantly alter the way in which most of the lab's work was accomplished. Tests would be processed on, essentially, the same types of equipment; but, test requests and reporting would be automated. Ms. Beta had become an employee at a very hectic time for the lab. She was given cursory training in the old manual methods. She used these procedures to help the other two receptionists but since they were already very proficient, they handled approximately ninety percent of the workload. As a result, Ms. Beta would spend much of her time away from her work station. The lab management staff did not keep track of her time. During the week before the system was to go on-line, she was given intensive training in the use of the system's data entry terminals. She seemed to have no difficulty mastering the new methods and was able to demonstrate sufficient proficiency in the use of the system's marked document readers (MDRs) and CRTs.

The lab and hospital management had decided to allow the lab to be the prototype site for LIS because the lab's workload had grown to a volume which would require automated information processing within the next three years. Already, the small analysis and reporting system that the CS staff had built for them was insufficient. All of the hospital's staff were either enthusiastic or indifferent to the system's potential. The lab management staff had committed itself to the success of the system after involving all of the lab technicians in the decision. The hospital management had fully supported the lab's decision and had

attempted to increase the lab's manpower to include data entry clerks, such as Ms. Beta, and the operators who would be required to run the new in-house CPU.

The hospital would be LIS's prototype installation. As noted above and as typical for many governments, the initial design for LIS was produced by the government's central staff. Run on a dedicated mini-computer, LIS would support the hospital 22 hours a day, seven days a week. It had most of the features of other laboratory information systems and provided direct result reporting to many nursing units. Test requests would be made by marking the appropriate tests and entering the patient and physician identification on one of a set of test ordering cards. Prior to a test requisition, however, the patient's demographic data would have to be entered into the system to create a master record for the patient. This ordering process would be manual until the cards reached the lab's reception desk. There, the cards would be entered into the system's MDRs by Ms. Beta and her co-workers. They would verify the information on the CRT screen and enter the demographic data on a special CRT screen if a master record did not exist for the patient.

Much effort had been devoted to the implementation plan. It provided for a phased departmental implementation and parallel processing with the manual system until the software was verified as correct. Additional, temporary personnel, like Ms. Beta, were

required for this effort since one of the two veteran reception desk workers was used for a job that required a stronger knowledge of the lab than a new employee would have. Unfortunately, the other vetern clerk accepted a different position in the hospital and was not available for the implementation effort. As a result, Ms. Beta suddenly found that she, with one month's experience, was the senior of the three data entry clerks.

The implementation was thrown into chaos, however. Ten hours after the implementation commenced, the director of the lab unilaterally decided to abort the phased-implementation plan and issued instructions to his staff and all clinical departments to immediately begin operation of the entire system. As a result, software testing was delayed and the CS staff's efforts had to be directed to preventing the collapse of the system. The vendor had not fully de-bugged the software and the first two weeks of the system's life were characterized by software failures and frantic software patches. However, the system was kept operational.

As the system settled into routine use after the first month, input operations reached a steady state. The workload at the reception desk was usually heavy, but the continuous use of two data entry stations satisfied demand. The third clerk was employed resolving minor crises and determining which medical departments were responsible for the most frequently encountered card preparation errors.

Approximately four weeks after the implementation began, physician complaints reached a critical level. The CS manager met with several physicians and learned that one problem which appeared to be widespread was that many of the normal values for tests were incorrect. Normal values were maintained in a system table, the indexes to which were: test type, age, race, and sex. The normal value functions were exhaustively tested at the beginning of the implementation and found to be correct. It appeared to the CS manager that either a sporadic software error was occurring or an interim software correction interacted with or damaged the normal value logic. His and the vendor's staff rechecked the normal value logic and could find no errors. Still, the problem continued. The CS staff then checked the data entry logic to see if it was altering the input data. It was correct, also. Next, the data entry transactions were checked. An inordinately high number of newborns (defined as age = 0) were found. Even more mysterious, many were found to have spouses and children. Further investigation revealed that one of the data entry clerks was not entering the patient's age in all cases and also was making random entries for some demographic data. When a CS staff member remained at the reception desk, the data was entered correctly. When the data entry clerks were left alone, the problems would re-occur. After correlating the problem incidents with the staffing pattern, Ms. Beta was found to be the offender. She denied this; but, when she was told that management could trace the errors to her and would take disciplinary action if the problem occurred again, the problem seemed to end.

Ms. Beta's actions were particularly hazardous to the care of the hospital's inpatients. A new group of interns had arrived at the hospital coincident to Ms. Beta's alteration of patient data. Many of these interns were not knowledgable about the normal values for infrequently ordered tests. They had a tendency to rely on the LIS test result report which flagged tests which were not within normal limits. Ms. Beta's activities led to a wrong normal range being associated with a result. Hence, some test results which were actually normal were flagged as abnormal and other truly abnormal results were indicated as normal. As a result, a harried intern might take inappropriate action to respond to a false abnormal and fail to react to a false normal. Additionally, her actions led to a loss of confidence in the system among clinicians and a cost of many man-days of problem tracking work on the part of the lab and CS staff.

Case III: An Admission, Discharge, and Transfer System

Mr. Gamma was employed as a clerk in the hospital's Admissions and Dispositions Department (A&D). He was one of approximately eight clerks who shared the many A&D tasks. A&D functions included patient admission, location of a bed, medical record creation, communication with the nursing units, tracking inter-unit patient transfers, bed status maintenance, patient discharge processing and miscellaneous administrative chores. Each clerk was fully trained in all of the tasks so that he could

be rotated onto night duty. The A&D room was manned 24 hours of each day of the week. Mr. Gamma and his co-workers frequently had to work overtime and always seemed to be at the point of friction between patient and medical staff demands and difficulties. The job of an A&D clerk was considered an entry level position. It had the unenviable reputation of being a job which one had to endure before being promoted up and out of A&D.

The decision to implement an Admissions, Discharge and Transfer (ADT) system was taken by the hospital's management in response to the government's central systems staff's design of the system. The system actually had several functions other than ADT. A&D data was used as input to its financial and cost allocation functions. The hospital was to be the prototype installation for the software package.

The A&D staff were advised of the proposed implementation after management had reached its decision. The A&D clerks learned that with respect to their involvement, the system would automate their manual methods without materially altering them. The A&D section would be provided with CRTs and printers and would no longer maintain their manual files and card indexes. The system would admit and discharge patients via CRT entries and some manual functions, such as preparation of the discharge notice for the billing office, would be triggered by a discharge without the need of an A&D clerk's intervention. The A&D staff were only minimally

knowledgable of the system's other functions.

A&D staff training by the central systems staff preceded implementation. Parallel processing was planned to end as soon as the software was validated. Unfortunately, a hiring freeze prevented hospital management from providing temporary workers to assist the A&D department during parallel processing. To partially alleviate this problem, one of the CS staff's worker's was assigned to A&D. The first two weeks of the implementation demonstrated that there were several functions not performing to specification and numerous software bugs. Additionally, the developers of the system had contracted for only one CRT which was insufficient to handle the four hour peak processing load.

After the first four weeks of the system's operation, it was decided to drop the manual census and patient location card indexes. A hospital-wide audit assured that the ADT system census and locator files were correct before the cut-over. Two weeks later, the new manager of the A&D department advised the CS manager that the census and locator files were hopelessly confused. He indicated that his employees had been complaining about the workload ever since the system had been installed. He decided to reinstate the manual system until the CS staff could discover and correct the computer's problem. After two days of work, the ADT files were reconstructed by the CS staff; but, no system problem could be found. A&D resumed the use of ADT and the

CS staff monitored the state of the files each night. It was found that data of every type would sporadically be erroneous; so, the CS staff called upon the central systems staff for assistance. The problems continued for two more weeks with no resolution, when one of the A&D clerks approached the CS manager and confided that one of her co-workers was deliberately changing the data he entered and discarding some entirely. She later denied the conversation; but, when the CS staff took control of the data entry function for a 24 hour period, an audit showed that the data they entered was correct in the system files. The CS manager then convened a meeting with the entire A&D staff to discuss the problem. Most of the clerks' comments were about the 'poor' working conditions and the meeting became an emotional release for the clerks, especially, the two female clerks who left the meeting in tears. They had few complaints about the system, except for the higher workload it caused. The CS manager advised the group that his staff would have to identify the individual who was destroying the database if problems continued. The data destruction never re-occurred.

The damage caused by Mr. Gamma never endangered a patient's health. However, it did disrupt the delivery of inpatient care. There was a cost associated with the efforts to trace and correct what was thought to be a software deficiency; but, this was not the greatest damage. Mr. Gamma's actions affected databases used as source data by other system's functions such as billing and workload accounting. The lack of data integrity caused the entire

implementation to stall and engendered a cascading loss of confidence in the system by both nursing unit and management personnel. The hospital did not fully recover from the effects of Mr. Gamma's actions for about three months.

Further Implications

The hospital-wide impact of these three incidents is difficult to ascertain. Both LIS and ADT had software problems and neither implementation occurred as planned. For each of these systems, the employee interference compounded other problems and brought them extremely close to total failure and removal from the hospital. The ECG system nearly failed as a direct result of the employee's interference. In each case, the hospital was forced to expend monies, time and other resources in an attempt to resolve the interference and repair its damage. It is significant to note that the hospital, which had implemented nine systems in five years, has not attempted to expand their systems capabilities since the ADT implementation, even though other systems were under consideration at the time.

An Attempt to Diagnose the Causes of the Resistance

Approximately one to two years after the implementations of

the systems were completed, the systems had reached steady states of operation and the problems associated with the implementations were no longer emotional issues. Open ended interviews were arranged with all of the available hospital staff who were involved in or knowledgable about the incidents. The purpose of these interviews was to attempt to uncover the causes or motivations for the interference. Understanding the cause for such action may lead to a better understanding of the MCBIS implementation environment and to more successful implementations in the future. It should be recognized that the diagnoses derived from these interviews only represents the informed opinion of the researcher and are not necessarilly correct in all aspects. Further, each diagnosis is only an attempt to derive the primary cause; it is not intended to be exhaustive.

Diagnosis: Case I

These findings were based on discussions with Mr. Alpha, his supervisor, the hospital administrator, the screening facilities' physicians, the hospital's cardiologists, the ECG technicians, the system vendor representative and the CS staff.

Mr. Alpha had been working in his position long enough to have revised its unofficial office procedures to what he considered optimal. He was content in his section's operation.

He, in fact, was nearing retirement, and had internalized his routines and modes of interpersonnal relationships years earlier. He was regarded as the personification of his section: when hospital management spoke of his section, they ofter referred to it as "Mr. Alpha's section." Mr. Alpha had a history of poor working relationships with other hospital staff when he worked at the main facility. In fact, he was transferred to his health screening section because it was a job which required few working contacts. He seemed to work well there; although, he had received some criticism of his performance in prior positions.

When Mr. Alpha first learned of the pending implementation of the ECG system, he felt that the system was a good idea but was annoyed that the decision had been made without his involvement. He commented that it was another case of the hospital interfering in his operation. Mr. Alpha first learned that he would also be working with the other screening section when the hardware arrived and room construction began. When dealing with hospital management, he became sullen and predicted that "the whole thing won't work." He was completely uncooperative and inflexible during discussions held to arrange joint use of the system. Mr. Alpha found that he was no longer in complete control of his section, a very different situation than normal. He claimed that before the ECG system, he had seen no hospital manager in his facility for over a year. Now, they were there daily. Additionally, he had to change some of his procedures to accommodate the system. He felt, due to these changes, that

management was, once again, unhappy with his performance and was imposing constraints on his authority. He found the new environment intolerable and decided to resist the system to rid himself of it. If the system were removed, he thought that he would be able to return his work environment to its pre-implementation state.

Considering the implementation as a change process (Ginzberg, 1975), it appeared that insufficient "unfreezing" occurred (Schein, 1971). Mr. Alpha was thrust, unwillingly, into the midst of a "change" phase. In his case, the lack of motivation to accept the change proved detrimental to the change effort. It appeared that the implementation of the ECG system, by itself, may not have caused Mr. Alpha to exceed his tolerance for change. However, management's decision to also alter the operational structure of the two screening facilities' ECG services compounded the change and it became unacceptable. Mr. Alpha saw the return to a pre-system state as sufficient reward to justify the risk of his actions, whatever that risk may have been perceived to be. A later, deliberate effort to unfreeze and motivate Mr. Alpha also failed. But, by this time, the change agents were perceived to be opponents and their failure to convince Mr. Alpha to accept the change should not have been unexpected. Apparently, the introduction of any system, MCBIS or other, which would have similarly disrupted Mr. Alpha's organizational environment would have been resisted by him.

Diagnosis: Case II

This diagnosis is based on discussions with Ms. Beta, her co-workers, her supervisor, the chief pathologist, staff physicians, the hospital administrator, system vendor representatives, and the CS staff.

Ms. Beta, a recent high school graduate, was hired as a temporary employee for the duration of the test of the lab system. She had been advised that the job could become a permanent one, but that since the system was a prototype, no promise could be made. Before her training on the system began, she had frequently been absent from her job for hours at a time. Employee management was weak in the lab, so she was seldom corrected for her work habits. Her sabotage of the system began shortly after the installation and, according to her co-worker, continued to a much lesser degree even after management had detected and "resolved" it.

During the implementation of the system, the workload at the laboratory reception desk rapidly increased, creating a very stressful situation for Ms. Beta and her fellow workers. The situation rapidly deteriorated due to the frequent failure of the system. When LIS failed, input operations from the reception desk would cease but the patients would still have to be provided care.

When the system was reinitiated, all data accumulated during "down time" would have to be entered, frequently requiring unscheduled overtime by Ms. Beta and other staff members. Further, these disruptions would cause angry practitioners to confront the receptionists, the outward personification of the lab to most staff and patients. Ms. Beta's job engendered almost constant stress and instability.

Although all three receptionists periodically expressed a strong dislike of the system and their work environment, the other two workers apparently coped with the situation. Ms. Beta's method of dealing with the situation was frequent sabotage and periodic absence from her workplace. One of her co-workers reported that her interference was frequently covered up by the other two. Evidence indicates that Ms. Beta reversed her behavior toward work only when she thought that there was a real possibility of securing full-time employment at the laboratory. This and other information imply that Ms. Beta calculated her payback from sabotage to be higher than her payback from compliance with work policy. Sabotage allowed her to vent her frustration with her work environment and stretched the implementation period during which she would be employed. It also required less effort. The probability was high that sporadic data sabotage would go undetected: she had almost no direct supervision; there was little quality control of her work; and, data errors would be masked by hardware failures and software bugs. Hence, sabotage ensued. Now she would neither have to

become proficient with the system nor cope with the environment. She could escape the trauma and retain her income. Later, when she discussed her interference by projecting it to another employee, who was known to be innocent, it was learned that she covered her continued, but occasional and random, data destruction by claiming them to be innocent mistakes, if discovered. This was unknown, however, when she was offered a full time position. The change in her status was a sufficient alteration in her reward structure such that she ceased her interference and adopted more orthodox work habits.

Diagnosis: Case III

These findings are based on discussions with Mr. Gamma, his co-workers, his supervisor, the hospital registrar, the hospital administrator, nursing unit personnel, the central systems staff and the CS staff.

Mr. Gamma was dissatisfied with his work environment before the computer system was implemented. When his government's central systems staff described the ADT system to him and his co-workers, he understood that it would make their work significantly easier and help reduce their overtime work. It would be far more accurate than their manual system, so it would help reduce the friction between the A&D department and the other

departments in the hospital. Thus, his and his peers' expectations were elevated during the unfreezing phase. Quite possibly, the work would be far more interesting, would better utilize his talents, and would provide more prestige to his job. He and his co-workers were enthusiastic about the new system.

Unfortunately, his expectations went unfulfilled during the implementation. His workload increased due to the parallel testing. The promised temporary employees failed to materialize in sufficient numbers to offset the additional work. Only one CRT was installed and it had hardware failures at room temperature. Cognitions (Feldman, 1966) developed, one at a time, that the system was far from what he had been led to expect. Hardware and software problems increased his frustration since he would have a backlog of patients awaiting service while he tried to update the database. These cognitions conflicted with expectations and demanded resolution which no available information was able to provide. Problems reached an intolerable level for Mr. Gamma when the continued training his division was to receive was sloughed off by the central systems staff in deference to system problem resolution. They indicated that the training manuals they developed would be sufficiently thorough to permit effective on-the-job training. But, when they left the hospital, their training manuals were found to be entirely inadequate.

Mr. Gamma recognized that the only respite he would have

from this burden would be when the data in the system were so unreliable that management would decide that they could not be used. Then, even if the A&D clerks still had to enter data, it would not be important that the data be complete or correct. Evidence indicates that his entire work group wished that the system would "just go away" until it worked correctly. This desire could actually be construed as the resolution to Mr. Gamma's cognitive dissonance (Festinger, 1972). Sabotage followed. His actions were reinforced when management decided to rely on the card file and other manual systems.

Three events occurred after the CS manager's meeting with the A&D clerks noted above. The A&D staff learned that the CS staff could isolate the offender; the negative implications of the sabotage were explained; and several measures were taken to improve A&D working conditions. Following this, Mr. Gamma ceased his interference and began a prolonged period of cooperation.

A Consideration For Other Hospitals

If the experiences of our case hospital were unique, their problems would be of little interest to the managers of the approximately 7,300 other hospitals in the United States. However, if their case is not isolated, interference could be one of the causes for the frequent inability of MCBISs to achieve full

success within many hospitals. This is not to imply that interference is the major implementation problem; but, rather, to suggest that it may be a factor either alone or in conjunction with other problems which leads to a system's failure to acheive the desired level of success during its implementation or operation. We have already noted some of the costs associated with MCBIS failures. However, we, to date, have had no information with which to estimate the frequency with which staff interference impacts the success of MCBIS implementations.

AN EXPERIMENT TO ESTIMATE THE LEVEL OF MCBIS INTERFERENCE

Purpose

If the case hospital has not been alone in experiencing interference which hindered an implementation or threatened the survival of a system, the problem may become an industry-wide concern. Therefore, we wish to estimate its level of incidence. There are numerous ways to define incidence; and, each will yield a different statistic. The definition chosen for this study is the number of hospitals which have experienced CBMIS interference with respect to the number of hospitals which have CBMIS experience. By experience, we mean that the hospital has attempted the integration of at least one MCBIS into their normal operating environment. The system could have been developed in-house or by any type of vendor. However, we exclude devices such as computerized axial tomography or chemistry analysis systems from being categorized as MCBISs.

If we find that the estimated level of incidence is more than just background noise, the events which occurred at the case hospital may be illustrative of typical interference manifestation. But, a major distinction of the case hospital was its government oriented management and funding methods. If the incidents were related to the fact that it was a government

hospital, this would provide an initial indicator for the direction of future research into the problem. If the problem is not related to government ownership, then our findings may be applicable to both the government and private sector health care delivery facilities. The problem may also become a concern to MCBIS vendors dealing with hospitals from either sector. The question then becomes: is the incidence of interference the same for hospitals from both the government and private sectors? We may resolve this question by testing the following hypothesis:

H1: $Pg = Pp$ where $P \equiv$ the probability that a randomly selected hospital has experienced at least one incident of interference given that it has had MCBIS experience.

$g \equiv$ government hospitals,

$p \equiv$ private hospitals.

That is, we hypothesize that the probabilities of interference are the same for both government and private hospitals.

The estimate of the level of interference and the test of the hypothesis, H1, can be accomplished through the execution of an experiment as described below.

Experimental Design

The experiment designed to estimate the level of incidence parameter and to test the hypothesis, H1, is of the quasi-experimental (R X O) type (notation: Campbell, 1963). That is, a randomized sampling of the population universe is made after the event has occurred. Each sample point represents a single Bernoulli trial whose outcome is actually an experimental value of the Bernoulli random variable x. The values which x takes on are:

x = 0 (the hospital has not had interference|MCBIS experience)

or

x = 1 (the hospital has had interference|MCBIS experience)

Recall that an incident is considered as interference, under our definition, only if it actually results in a cost in time, money or other tangible resource. Such costs could range from an actual delay of the implementation to the complete failure of the system.

The experiment will be a series of Bernoulli trials which are defined as a Bernoulli Process. The random variable K is the number of hospitals which have experienced interference in n trials, the sum of n independent Bernoulli random variables. K is defined by the binomial probability mass function (PMF). The sample size n was chosen to be forty trials (n = 40) to allow the use of the Gaussian approximation to the binomial PMF when the

probability of interference P is not extreme (i.e.: P does not approach 0 or 1). More formally,

$$P = \text{Prob}(R|E) \quad \text{where } R \equiv \text{the hospital has experienced MCBIS interference,}$$
$$E \equiv \text{the hospital has had MCBIS experience.}$$

n will be an equally sized two cell sample. The cells will represent twenty trials each, for both government and private hospitals. To control for the fact that the case hospital was a short-term facility, the sampling population will be restricted to the approximately 6,700 American short-term hospitals. Further, the trial will count only if it fulfills the conditioning event E, that the hospital has had MCBIS experience.

Data Collection

Since the data collected about interference are of a sensitive nature and since the success of data collection depends on the cooperation of the hospitals randomly selected for the survey, absolute accuracy on the part of the respondents cannot be guaranteed. The experiment's forty trials were operationalized via directed but open ended questions in a telephone survey. The respondent(s) at each hospital was chosen as the manager(s) most

knowledgable about the hospital's MCBISs. Initial contact at each facility was with the hospital administrator's or director's office, which would provide the initial referral.

The survey was structured as follows:

-an introduction of the interviewer;
-an explanation of the purpose of the survey;
-initial questions about the types of the hospital's MCBISs;
-an explanation and example of interference as defined in this study;
-questions about the incidents of interference in his hospital: its frequency, manifestation, perpetrator, detection, and possible cause.

A hospital was rejected from consideration if there was no individual currently employed who was sufficiently knowledgable about any MCBIS implementation. As this implies, if one such person could be found and he had personal knowledge of at least one of the hospital's MCBIS implementations, that hospital was accepted as a sample point. A hospital would also be eliminated if its management proved either unwilling to participate or uncooperative after agreeing to participate. Of course, the case hospital was eliminated from consideration. No incentives were offered for participation. The selection strategy called for repeated trials until a sample size of 40 was attained. The

actual selection was by a random number index into the list of short-term hospitals contained in the 'American Hospital Association Guide to the Health Care Field' (1978 edition). The random numbers were generated by a Fortran IV program accessing the PRIME 400 random number function, using the CPU's clock time in centiseconds as the initial seed. A total of 58 hospitals were contacted before the desired sample size was completed. The following list describes the reasons for the 18 exclusions:

- 1: hospital closed and held under a court trusteeship
- 1: administrator not available for 10 calls
- 4: no one knowledgable was still employed
- 2: staff was uncooperative
- 10: no MCBISs

As these statistics indicate, the cooperation of the management of the vast majority of hospitals was excellent. However, the hospitals which were excluded from the sample, other than the ten which never had MCBIS experience, could induce a bias to the results. Each may or may not have had an MCBIS interference incident or, indeed, may never have had a system. The reader should be aware of their potential for bias even though the vector of bias is unknown.

Parameter Estimation

For this experiment, a Bernoulli process, the estimated probability of interference, $\hat{P}$, is derived from the maximum-likelihood estimator,

$$\hat{P} = \frac{K}{n}$$

The survey found that one or more incidents of interference occurred in 18 of the 40 hospitals which comprised the sample set. Thus, the estimate of K, $\hat{K}$, as calculated from the survey is:

$$\hat{K} = \sum_{i=1}^{40} x_i = 18$$

Thus,

$$\hat{P} = \frac{18}{40} = 0.45$$

and the confidence interval for $\hat{P}$ with $\alpha = 0.05$ is:

upper limit: $$\bar{P} = \frac{(K + 1)\, F_{\alpha/2;\ 2(K + 1);\ 2(n - K)}}{(n - K) + (K + 1)\, F_{\alpha/2;\ 2(K + 1);\ 2(n - K)}} = 0.6153$$

lower limit: $\underline{P} = \dfrac{K}{K + (n - K + 1)\, F_{\alpha/2;\ 2(n - K + 1);\ 2K}} = 0.2748$

that is, 95% of all experimental $\hat{P}$'s derived from similar samples of the population under observation would fall in the interval (0.2748, 0.6153). Hence, we conclude that:

> the estimated probability that a randomly selected short-term hospital, which has had MCBIS experience, would have experienced interference is 45% and the estimate's confidence interval ranges from 27.5% to 61.5% at the 5% level of significance.

<u>Testing Hypothesis H1</u>

Since $\hat{P}$ is not an extreme, we may use a Gaussian approximation to test H1. We wish to compare the estimated percentages of incidence in government and private sector hospitals, so

$$U = \frac{\sqrt{n}\ (Pg - Pp)}{\sqrt{(Pg + Pp)\,(1 - \frac{Pg + Pp}{2})}}$$

approximates a Gaussian distribution and we will reject H1 when

$U > J_\alpha$ where $J \equiv$ the σ associated with the α percentage point of the standardized Gaussian PMF.

The experimental results showed that each category of hospital in the survey, government and private, contained nine hospitals which indicated that they had experienced interference. Thus,

$$\hat{P}g = \hat{P}p = 0.45$$

We want this test to be constrained to have a high probability of rejecting H1 so that it will be discriminating. We, therefore, set $\alpha = 0.5$, and we will reject H1 when

$U > 0.675$ where $J_{\alpha/2} = 0.675 \mid \alpha = 0.5$

but,

$$U = \frac{0}{1.204} = 0$$

so we accept

H1: Pg = Pp

and reject its alternative hypothesis,

H1a: Pg $\neq$ Pp

To give a better perspective of this test, which due to the equality of $\hat{P}g$ and $\hat{P}p$ would have accepted H1 at the 0.99 level of significance, values of $Kg \pm 1$ or $Kp \pm 1$ would have satisfied this test at the $\alpha = 0.85$ level. We, therefore, conclude that

> we do not have statistical evidence to disprove H1. As a result, we estimate that the incidence of MCBIS interference is approximately the same in both government and private sector short-term hospitals.

Types of Resistance Found in the Survey

The manifestations of interference found in the surveyed hospitals were fairly diverse, but began to cluster into recognizable syndromes. Sixty-six percent of the incidents were characterized by the manifestation of multiple types of interference. No incident involving overt, violent interference was found. Rather, most individuals who resisted an MCBIS did so in one of the categories described below. The reader is cautioned that the incidents reported represent the allegation of the respondent. However, significant care was taken in an attempt to exclude any incident which the respondent did not believe to be deliberate. As a result, several alleged incidents were not admitted since the respondent was not certain that they were not

accidental. This research did not attempt to discover the reasons for the interference in the surveyed hospitals. So, the reasons given by the respondents will not be enumerated here. Examples of each interference category will be described, however. These incidents were found either in this research or in supplemental discussions held with the staffs of six MCBIS vendors.

Type I: Passive Resistance: This occurred when hospital staff used various acts of noncooperation with the other hospital staff members and system vendors who were attempting to implement the system. In one hospital, the Controller was the system's primary advocate. Under perceived political pressure, the manager to whom he reported gave him permission to install the system. But, when the time came to cease parallel processing and cut-over to the new system, upper management withheld permission to cut-over and withdrew support for the system. As a result, parallel processing continued, unnecessarily, for six months. In another hospital, the chiefs of several medical departments, who were opposed to a workload reporting MCBIS, refused to make their employees available for system training for a prolonged period of time. This forced a delay in the implementation schedule, during which time, systems costs were still accruing.

Type II: Oral Defamation: This is the attempt to spread dissatisfaction with a system by expounding its undesirable attributes or by fabricating problems. The top management of one

hospital was told that the MCBIS's CRTs were always breaking and almost had the entire system removed from the hospital. Then, management learned that the chief complainant, a data entry clerk, was periodically dismantling parts of her CRT and halting her work until it was repaired. Case I, described above, is another example. Mr. Alpha was causing system inaccuracy and then claiming the system to be a medical liability.

Type III: Alleged Inability to Operate the System: This manifests itself when an employee takes an uncharacteristically long period of time to learn how to use the system and makes an inordinate number of data "errors," attributing them to his inability to use the system. In one hospital, all clinic clerks demonstrated that they were able to correctly mark boxes on a data input form during a training session. Subsequently, in several clinics, the clerks opposed to the new data collection method made "mistakes" preparing forms. Their "mistakes" continued for three months and caused input reject rates which exceeded 50%. In other clinics, the form reject rate ranged from 0% to 3% during the same period. The problem was so severe that all of the input data to the accounting system for those three months was useless.

Type IV: Quality Control Failure: This type is somewhat akin to Type III. It occurs as a failure to control the quality of the data input process and results in data destruction. Data sabotage falls within this type. The billing clerk in one

hospital had over ten years experience in the hospital's manual billing office. She was known for her accuracy and reliability. After stating that she did not like the computer system, she began to prepare bills incorrectly. This resulted in many patient complaints, significant problems with third party payers, and a possible loss of revenue. Ms. Beta of Case II and Mr. Gamma of Case III may also be placed in this category.

Type V: Refusal to Use the MCBIS: This occurs when a key system user refuses to use the system or when an influence leader causes others not to use the system. This category of interference is the most obvious. One hospital which installed a hospital information system, found that the nursing units' communication subsystem was still not being used to place orders to ancillary departments or to communicate patient information to the admissions/discharge office long after the system's installation. Management discovered that the nursing director disliked the system because she would have to be trained to use the system and she was afraid of failure. After 30 years of experience, she simply "refused to become a trainee." The subsystem is still unused by the entire nursing staff. Another hospital's computerized poison control information system was essentially unused for over one year because the chief emergency room physician "didn't want it used." And one hospital's financial system, a replacement for a prior system which "failed," almost followed suit. One of the financial officers was not using the system's report that flagged transactions requiring human

intervention to resolve. As it turned out, the hospital's cash flow problem was not due to system problems but to the financial officer's "fiscal irregularities," which the unused reports would have uncovered. Still, one vendor had to remove his system and never knew why.

CONCLUSIONS AND RESEARCH RECOMMENDATIONS

This research has demonstrated that staff interference in MCBIS implementation can affect the survival of the system, the organizational health of the hospital, and the quality of care provided to the patient.

Although an attempt was made to discover the primary cause of the interference in the three initial cases, each incident had numerous contributing and interacting causative factors. Most centered on the individual's inability to accept change. In some instances, the change was 'good' (e.g., one which led to improved patient care), in others it was 'not good' (e.g., it degraded the working environment). In a few cases, the system was otherwise acceptable but was interfered with to capture management's attention for other purposes. The following list of contributing factors was compiled from the cases and the hospital survey:

-Pre-existing organizational problems which the system or its implementation may or may not aggravate. The system, due to its management support and/or visibility may serve as a platform for individuals to express prior dissatisfactions.

-Failure of the change process. Management, if they attempt to manage the change process at all, may move to the change phase

before the unfreezing phase has been successful. Or, psychological support which reinforces the adoption of new organizational norms is either non-existant or is removed before "refreezing" occurs.

-Insufficient resource support for the implementation effort. Manpower, time or other resources may not be made available in the manner needed.

-Hardware and software problems. Insufficient software and hardware verification before installation can cripple the hospital's operational capacity, endangering patient care and organizational viability and inducing justifiable interference to the system.

-Confounding and magnifying the change engendered by the system with other organizational change. Often, management attempts to implement other changes which are irrelevant to the system's operation when the system is implemented. Massive experiential data indicates that a system is not automatically a cure for organizational ailments and that compound changes may cause interference which is vented on the system.

-Lack of user involvement. Allowing early user involvement has risk, however, it usually assists unfreezing since staff may come to perceive the system as their own. Early user involvement is also important since it is the primary mechanism to assure that the system's functions are actually useable in a real environment.

-Inattention to staff reward structures. Frequently, the implementation process may alter the individual's reward and risk structure such that he is motivated to actions insolubrious to the system.

-Failure to meet staff expectations. Frequently, system advocates raise user expectations in an effort to "sell" the system and gain initial cooperation. Usually, this is more detrimental than beneficial.

These factors are not unique to hospitals but are common to many industries. However, the rate of turnover of MCBIS vendors may be an indication that these implementation problems are being ignored or that they have a weighting which is different from other industries.

The estimation and hypothesis test results lead us to conclude that the case hospital was far from alone in its difficulties with staff interference. The government and private sector hospitals have approximately the same incidence of interference. The probability that a randomly selected short-term hospital has had staff interference with their MCBIS implementation, assuming that they have or had an MCBIS, was estimated to be approximately 45%. The 95% confidence interval for the estimate is from 27.5% to 61.5%.

These results indicate that the problem is more widespread and serious than most of the MCBIS vendor managers and hospital managers realized. Four of the six vendor managers indicated that they were unfamiliar with such incidents. The awareness of the problem among vendor staff varied directly with their proximity to the implementation environment. Hospital managers tended to think that these occurrences are rare or unique to their hospital. However, MCBIS implementations in the surveyed hospitals resulted in: one person being removed to another position, five people quitting, three being fired and one whose removal is being processed.

The systems with which the forty surveyed hospitals have had experience were the software products of 25 commercial MCBIS vendors, one university, two cooperative hospital groups, several local banks, numerous government agencies, as well as their own internal staffs. In the surveyed hospitals, 29 of 80 systems had ceased operation. Most were replaced by another system which served the same function. But for nine of the original systems, no information is available about their implementations. So, an estimation of the number of systems failures contributed to by staff interference would be highly unreliable. It is only known that some of the 29 systems were removed for upgrading; several were research prototypes which the hospitals chose not to continue to support; and, several were rejected because the hospitals were not satisfied with them in some way. Staff interference occurred in each of these categories to varying degrees.

The need for research on the subject of staff interference in MCBIS implementation is significant due to the human and organizational costs involved and the need to design improved systems and implementation processes. Two approaches to coping with the problem are: (a) the detection of interference, particularly of database damage, and (b) the prevention of interference. Since the trusted agent may be the problem, most traditional computer access restriction methods must be augmented by new methods. One approach may be for the software to compare input data distributions with expected probability distributions. Actual distributions which, over time, do not match expected parameters would be a signal that the input data could be faulty. Although costly, this method may be feasible for critical patient data. However, detection implies that some damage has already been sustained. Further, some types of interference are very difficult to detect. Prevention is, therefore, preferred. To do this we must have methods for predicting and treating the causes of the interference. Current methods are, generally, sets of management heuristics whose power varies among managers. It appears from this research that these methods are too often insufficient. Thus, research to augment current heuristics with new methodology is indicated. Implementation methodology which provides feedback mechanisms for appraising the staffs' reactions should be useful in signalling impending difficulties. In two of the three cases presented above, appraisal of the pre-system environment and advanced diagnosis of the system's effects on the staff would have alerted management to impending problems. Thus, these and other Organization Development methods should be tested

to demonstrate their applicability to the interference problem. Although such research outputs may not guarantee future success, they may be worth the effort if the interference problem can be sufficiently damped.

Research is also needed to further identify the types and distributions of costs and impacts which staff interference has in an MCBIS implementation. Without such information, the level of effort warranted to develop prevention and detection methods is unknown.

MCBIS implementations in American hospitals have often been difficult and costly experiences for both the hospital, its staff and the system vendors. Staff interference may have been a causitive or contributing factor of some of the implementation problems, since the research presented herein demonstrates that such was the case in 45% of the surveyed hospitals. Applying this estimate to the entire hospital population indicates that the staff interference problem has the potential for enormous negative impacts on the hospital industry as the number of hospitals attempting MCBIS implementation increases. Clearly, the problem deserves further attention.

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